STAMFORD MASTER PLAN 2000

GROWTH MANAGEMENT STUDY

TRAFFIC AND TRANSIT REPORT

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Regional Plan Association (NJ NY CT)

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TABLE OF CONTENTS

INTRODUCTION

TRAFFIC AND TRANSIT, GROWTH MANAGEMENT AND THE FOUR GOALS OF THE MASTER PLAN

This traffic and transportation study is one of three foundations for the larger Growth Management Study which describes the interaction of three sets of issues:

- Economic growth – how much new employment and population growth there may be over the next twenty years
- Urban design – where should Stamford grow and what should new development look like
- Traffic and transit – how will residents and workers/employees travel to, and around Stamford.

In order to understand the consequences of growth, the Growth Management Study modeled three futures – slow, trend and high growth and for each of these possible futures, policy recommendations are made.

The Growth Management model validated what policymakers suspected initially – that population growth and transportation issues are the biggest constraints on Stamford's prosperity. Quite simply, an ever-widening gap between employment and population translates into the need to bring more workers into Stamford, commuting from distances that are farther and farther away. This is a trend that in the long-term cannot be sustained.

As summarized below, and described in detail elsewhere in this report, the Traffic and Transit study shows that it is possible to manage future traffic problems even if Stamford continues to grow as it has over the past decade, but only by deploying an aggressive mix of strategies that includes cooperation by employers, more transit and, most importantly, strategic land use decisions: Stamford cannot build its way out of its traffic and transit problems by widening roads and reconfiguring intersections without destroying the Quality of Life of the Neighborhoods. New housing and new commercial and industrial developments must be in locations and in configurations that support transit.

It is this last strategy - land use – that links the Traffic and Transit study to the other Goals and Objectives of the Master Plan. The design guidelines in the Urban Design Report, and summarized in the City Beautiful section of the Action Plan, assure that new development is contextual and reinforces the neighborhoods. The design studies in the Downtown section of the Action Plan demonstrate that the completion of downtown will not only protect the neighborhoods from unwanted intensification, but will put development where it is accessible to transit.

SUMMARY OF KEY FINDINGS

The Growth Management model quantified the dimensions of the growing population-employment gap and established some concrete traffic and Transit benchmarks and goals. Most of the detailed Traffic and Transit recommendations in this report are summarized in the Neighborhood Quality of Life and Downtown sections of the Action Plan. Below is a summary of some of the more important findings.

- ***Future housing must be predominantly in the downtown, proximate to transit and to employment centers, to ameliorate traffic problems related to future growth.***

In the initial modeling, future housing growth was assumed to be distributed throughout the city. This had the desired effect of reducing traffic at key gateways into the city, but the perverse effect of making local neighborhood traffic worse! Only by putting 80% of future housing growth in the "greater downtown" (including Mill River, Bedford/Summer Streets & Southend), were the beneficial impacts realized. The balance of the housing growth would be for neighborhood revitalization efforts outside of downtown.

- ***Traffic problems in Stamford will get worse and will need to be addressed even if Stamford grows slowly over the next 20 years.***

In relative terms, the relative costs to maintain existing levels of service even under a "slow growth" scenario, will almost double. Stamford will also continue to be impacted by worsening conditions on Interstate 95 (I-95) and the Merritt Parkway as a result of the regional growth pattern. I-95 has limited right-of-way for any future capacity improvements. The Merritt Parkway is designated as a scenic parkway, and no capacity improvements are scheduled. It is also true however, that in a low growth scenario, it is possible to mitigate traffic impacts with the least ambitious measures and those that are all within Stamford's local control – traffic demand management (TDM -) and some strategic land-use decisions for directing development to downtown. needs some rewording here

- ***It is possible to mitigate traffic impacts of even the most ambitious growth scenarios.***

If a combination of measures is employed – TDM, more transit and more housing – it is possible to hold the relative increase in the costs for mitigation to the same level as that for Stamford's most likely future, that of trend levels of growth. In fact, in the most optimistic set of events, it is possible to reduce the growth in traffic entering Stamford from the two major highways to levels lower than existing conditions today! However, this is only possible by deploying the most aggressive mix of mitigation strategies – assuming extraordinary will on the part of policymakers with regards to land-use decisions; almost complete cooperation by

employers on TDM; and the partnership of state and regional entities to address transit issues and regional highway issues. Put simply, there is a direct relationship between levels of growth and the political, economic and technical effort required to mitigate traffic.

- ***There is no magic bullet.***

As the analysis demonstrates (see Figures 2 and 3), the only way to make significant inroads into Stamford's traffic challenges is by combining various measures. No one set of strategies works. From a policy perspective, this both adds to the complexity of the challenge and increases the opportunities for action. Stamford should be prepared to move on all fronts simultaneously – to promote and take advantage of whatever opportunities present themselves in any of the three possible futures described in the Economic Development study – whether it is persuading a major employer to implement flex time or lobbying ConnDOT for more reverse service trains.

LEVERAGING REGIONAL COOPERATION

The future growth of Stamford and the associated traffic and transit issues need to be addressed in a regional context. Stamford's willingness to envision anything more than slow growth must be accompanied by the acknowledgement of Stamford's strategic role in the Fairfield County and regional economies. Stamford must leverage its willingness to undertake the mitigation measures that Stamford controls locally – TDM and land-use related actions – into cooperation by other entities to address issues beyond Stamford's local control – such as regional transit improvements. This is especially true in regards to the regional highway network, where Stamford's local efforts can have a significant impact on the Merritt Parkway and I-95 problems for the rest of the region.

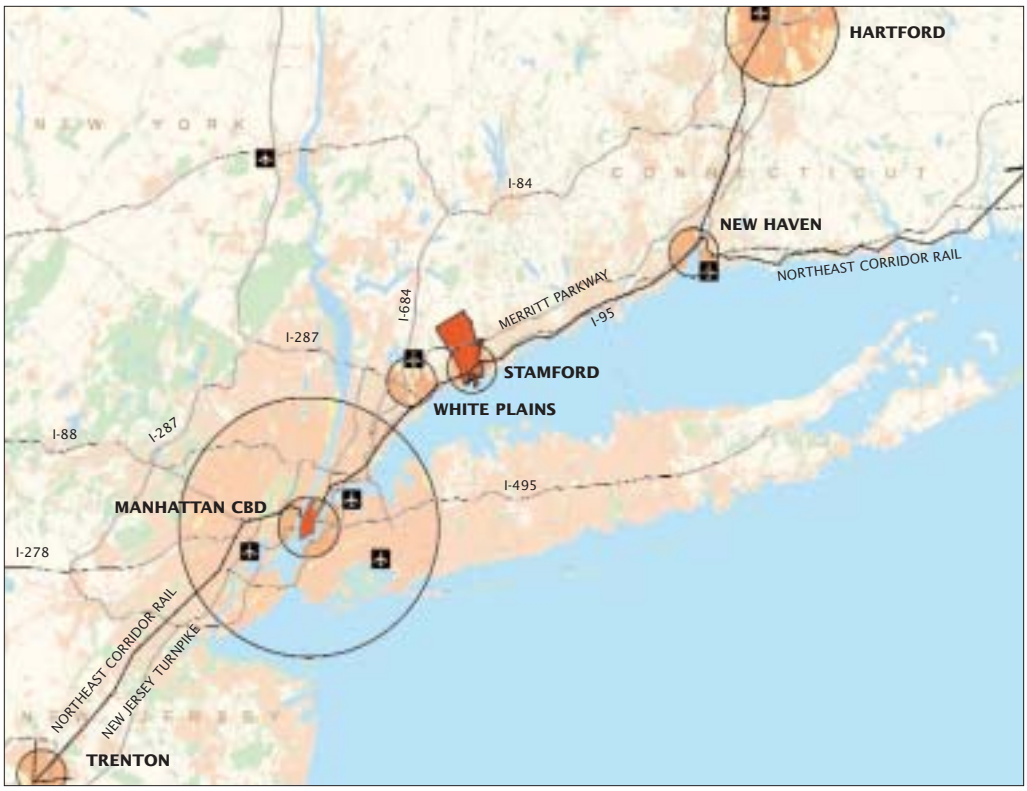
The Policy matrix at the back of this report summarizes the kinds of actions that need to be taken in terms of degrees of difficulty and implementation responsibilities.

STAMFORD IN A REGIONAL TRANSPORTATION CONTEXT

Stamford's growth can be traced to its excellent access to the New York City and New England. Two major highways – Interstate 95 and the Merritt Parkway – connect Stamford to New York City to the south and New England to the northeast and to the highway network of the New York Region and beyond. The Merritt Parkway, one of the first limited-access highways in the nation, was built in the late 1930s and Interstate 95 (then known as the Connecticut Turnpike) was completed in the 1950s. I-95 also provides the major truck route between New England and the mid-Atlantic states and points south and west.

The Metro North's New Haven rail line connects Stamford to the Manhattan's Grand Central Terminal 33 miles away with 77 trains each way each weekdays, and 45 trains each way on weekend days. Travel times can be as short as 46 minutes. This frequent and fast service has made it desirable for many firms to relocate from Manhattan to Stamford, and still in close contact with customers, suppliers, and New York's financial institutions. Stamford also benefits from being a major stop on Amtrak's Northeast Corridor, with service to Boston to the north and New Jersey, Philadelphia, Baltimore and Washington to the south. Amtrak stops 32 trains in Stamford on weekdays and 28 on weekends and holidays.

In the last few years the benefits of highway access have begun to wane as both the Merritt and I-95 have become seriously congested during commuting periods, with slowdowns at other times. But numerous accidents and anti-tax sentiment caused the state legislature to drop the tolls in 1985. Some of the growth in traffic on I-95, especially for short trips that formerly used the parallel US 1, can be attributed to the elimination of tolls in 1985. In the 1980s and 1990s proposals were put forth by the State of Connecticut to widen both of these highways. But opposition from neighboring communities and the huge cost of construction has left each of these roads with the same basic dimensions. Some improvements have been made on the



Merritt Parkway to overcome safety problems associated with inadequate entrance and exit ramps. I-95 originally was a toll road with toll barriers across the highways. Desperate to easy congestion on these roads, in 1998 the State Legislature legislated a drop by 5 percent in peak period traffic, requiring the Connecticut Department of Transportation (ConnDOT) to come up with plans that would meet that goal. ConnDOT produced a report that called for the elimination of some exits to reduce short trips, marketing of public transit, more commuter parking spaces at other stations on the New Haven line, and more ridesharing, among other proposals. The Connecticut Coastal Coalition, a coalition of planning and civic groups produced a parallel proposal that include these actions and others, including land use, pricing measures, and transit improvements that ConnDOT were unwilling to consider. Despite these reports, traffic congestion has remained a serious and growing problem. While tolls continue to be an anathema to most Connecticut citizens, barrier-free toll collection is now possible, avoiding the previous safety hazards, and raise funds to support alternatives to driving in the corridor.

Access to the three major airports in the New York Region (Newark, Kennedy and LaGuardia) is dependent on the highway network, which is often congested and unreliable. Stamford residents and workers are much closer to Westchester County airport just over the state border, but flight options are limited. Tweed Airport in New Haven offers still fewer flights and Bradley Airport outside Hartford is distant. Limousine service to LaGuardia and Kennedy airports is an option that is taken advantage of by many in Stamford. The opening of rail access to Newark Airport from an

Amtrak station in October 2001 and from the Long Island Rail Road in 2003 can provide ground option to Stamford residents working in Manhattan. Should ferry operations start in Stamford the services offered will include a ferry link to LaGuardia Airport, as well as to Manhattan.

In recent years, Metro North has lowered fares for intra-Connecticut and "reverse" travel from New York City to Stamford and other Connecticut stations, with spectacularly positive results. In 1993, intra-Connecticut fares were lowered in some markets, producing ridership gains of up to 10 percent. Revenue grew more for those station pairs with lowered fares than those whose fares were not lowered. In 1994, the success of this program led to fare reductions for "reverse" commutes from The Bronx to Greenwich and Stamford. Fares were lowered by as much as 20 percent and ridership responded by growing 34 percent, yielding a net revenue gain of 17 percent in those markets. Finally, in 1997 fare reductions of six percent for reverse commutes led to a 21 percent increase in ridership, and a 5 percent reduction in intra-Connecticut commuter fares produced a 15 percent growth in ridership. Each of these actions produced more, not less revenue, belying the conventional wisdom among transit operators that you cannot make up the revenue if you lower fares.

WHAT DOES THE FUTURE HOLD?

The prospects for congestion relief on the two major highways passing through Stamford will depend more on reductions in demand than on increases in supply. The latter is unlikely. Transit improvements, transportation demand management and shifts in development patterns offer some hope of traffic reduction, or at least in stemming the tide of increased delays. But these measures are hard – land use changes, expensive transit improvements, and very active employer participation are needed. Specific actions that appear to be the most promising are increases in parking supplies along the New Haven line, increased frequency of commuter service, increased cost of parking in Stamford (now free to most employees), and expanded market rate housing in or near downtown Stamford.

The new Amtrak Acela high-speed rail service from Washington to Boston, which stops all its trains in Stamford will help, and will also lower the reliance on airports for short trips to destinations like Boston, Philadelphia and Washington. Expectations should not run too high for a very high speed rail service (over 150 miles per hour) to succeed the Acela service, which still averages well under 100 miles per hour for the Stamford to Boston leg. Such service would require new rights-of-way that would be very expensive and encounter massive local opposition.

Ferry service connecting Stamford with either Manhattan or to Long Island has been discussed recently. The Manhattan service would operate directly to lower Manhattan, obviating the need for commuters to use crowded subway connections at Grand Central Terminal. The service would be very costly, with high fares limiting its ridership. Only a niche market of high income commuters living within reasonable drive of the Stamford ferry slip and destined for portions of lower Manhattan close to the ferry landing along the East River can be expected to use it. Ferry service for commuters working in downtown Stamford who live on the north shore of Long Island is pos-

sible. Most of Stamford's major employers are downtown and within easy access of the ferry terminal site. However, the dispersed residential locations, limited market and inaccessible shore locations on Long Island reduce the likelihood of a successful operation.

The discussion about rail in recent months has centered on the idea of extending a new rail service from Rockland County to Fairfield County as part of the current initiative to re-build the Tappan Zee Bridge. This project, as well as any new rail lines from northern Fairfield, Litchfield or northern New Haven Counties would have to overcome huge capital costs, spread-out origins and destinations leading to modest ridership and competing transportation needs.

ON-GOING TRAFFIC AND TRANSIT INITIATIVES IN STAMFORD

The primary purpose of this report is to describe how traffic and transit issues will be affected by different levels of future growth in Stamford and to suggest policies for managing traffic in the future.

However, it is important to note that the Engineering and Land Use Bureau has been, and continues to be, proactively involved in dealing with Stamford's current traffic and transit issues, identifying short, medium and long-term actionable initiatives that are complementary to the more theoretical exercise described in the following chapters. There is a full time transportation planner on staff who deals with everything from new building applications to long-term capital projects.

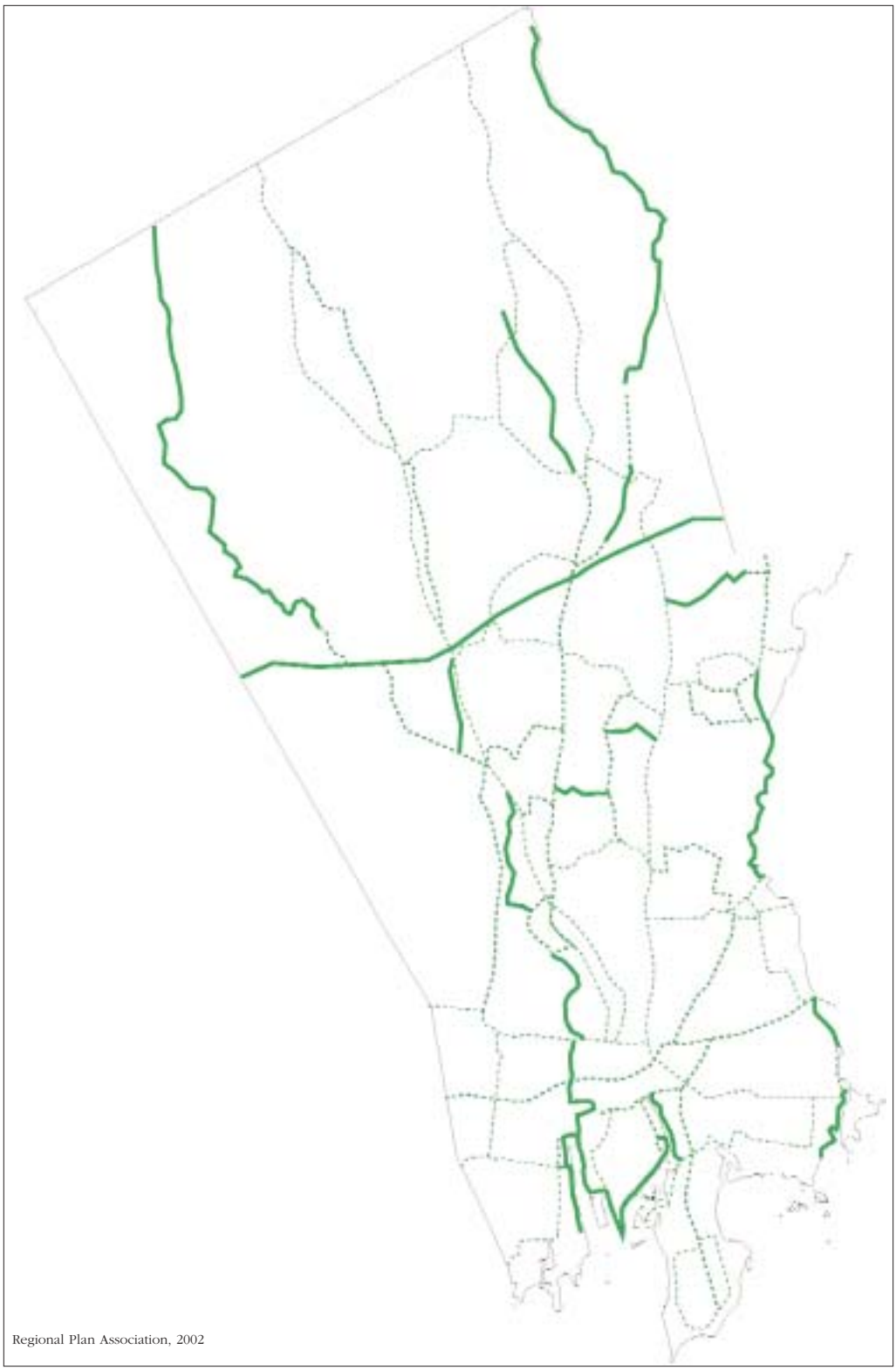
TRAFFIC MANAGEMENT

Traffic management includes the full array of projects that are, in general, short term and not capital-intensive. Some of the current initiatives include on-going traffic calming projects, the recently released design standards for streetscape improvements and the downtown parking management plan. The City is working with the Downtown Special Services District on pedestrian safety and walkability issues. Major streetscape and pedestrian projects are planned for North Street (Washington Boulevard to Summer Street) and on Washington Boulevard (Broad Street to Tresser Boulevard). Stamford is also working on a "Safe Route to School" program to address the pedestrian and bicycle barriers between neighborhoods and schools. It is worth noting that the "walk to school" program is a centerpiece of the national "healthy communities initiative" which seeks to address chronic health issues in children through increased activity levels.

ROADWAY AND INTERSECTION PROJECTS

While Stamford cannot build its way out of its traffic problems, there are many important capital projects that are critical to managing traffic. Recently completed projects include the Hoyt Street Connector and the re-design of Grove Street. Other roadway and intersection improvements are planned for Hope Street (Knapp Street to Minivale Road), Courtland Avenue (Hamilton Avenue to Route 1) and Greenwich Avenue (South State Street to Selleck Street).

The most significant of the new capital projects is the Stamford Urban Transitway, a project that will not only facilitate east-west mobility in downtown, but sponsor appropriate re-development, as described elsewhere in the Master Plan, of underutilized and abandoned properties adjacent to I-95 in the South End. This is a multi-modal transit way that will promote walking and biking between



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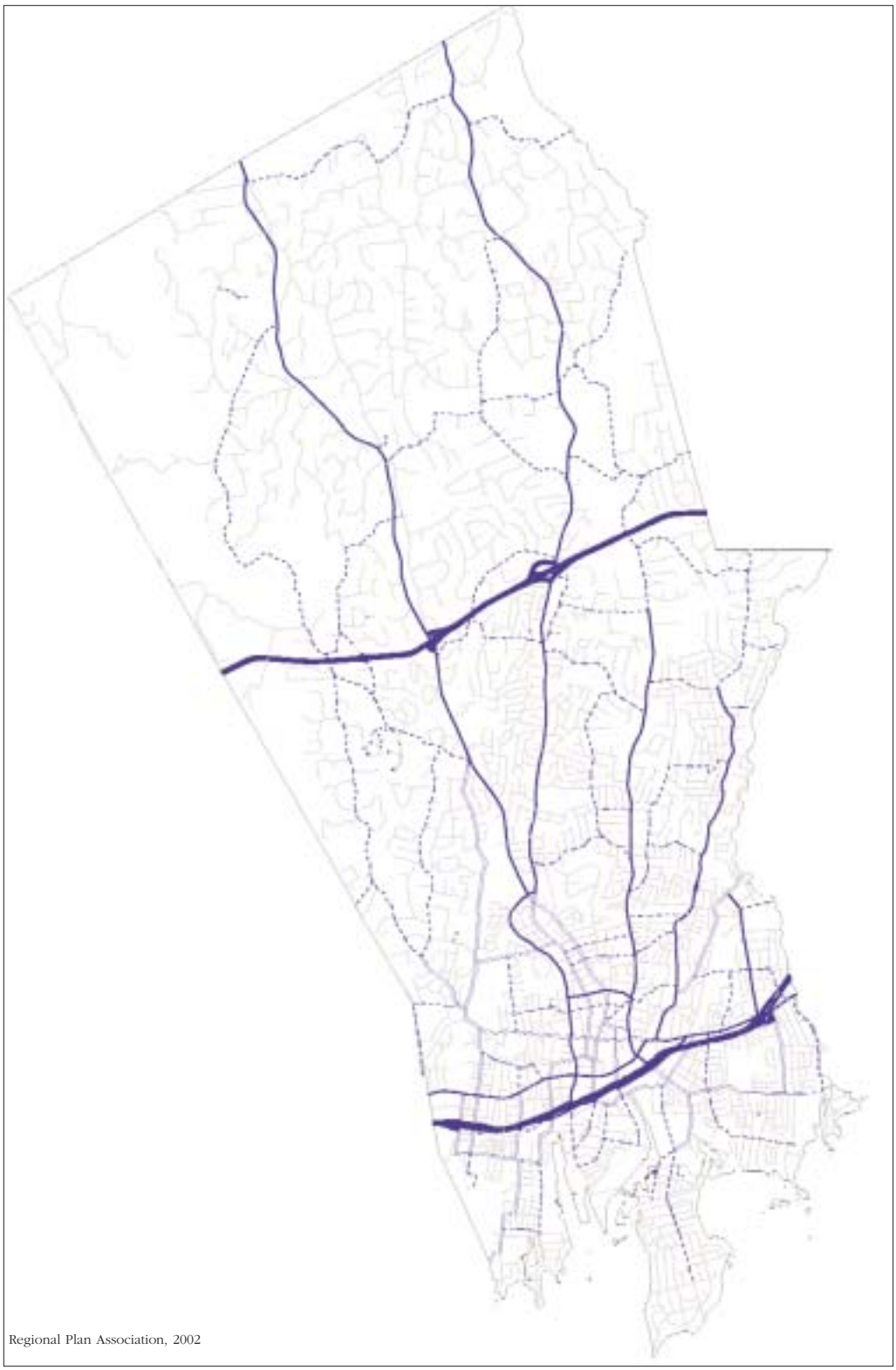
Bicycle and Trail Network

Shared Use Path

Bike Lanes



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destinations and to the Transportation Center. A subsequent phase is planned along Myrtle Avenue to facilitate connection to East Main Street (Route 1).

As described in the Urban Design Report, Washington Boulevard and Tresser Boulevard create the west and south boundaries to downtown. While these roads will continue to handle large volumes of traffic, they must also work as true "boulevards" – pedestrian-friendly environments with a distinct architectural character. To that end, Stamford is working on the design of these roads, including the increased pedestrian crossings and the creation of a landscaped center median.

As with other Cities along the New Haven Line, I-95 and the railroad trestles are enormous physical and psychological barriers. Stamford is actively working on the re-design of these underpasses to make them safe, attractive and more like gateways rather then barriers. Current initiatives are focusing on Atlantic Street, Elm Street and East Main Street.

TRANSIT-RELATED PROJECTS

Transit opportunities must be maximized if Stamford is going to manage its traffic problems. There are also equity issues in providing access to jobs and amenities for populations that do not have access to one or more cars. Stamford is currently promoting several transit-related initiatives.

The most visible, are the improvements to the Transportation Center, one of the most important regional transit assets, and its immediate environment. Dimensions of this include the new center island platforms, enhancements to the pedestrian connections from the Transportation Center, in particular the new gateway under I-95; and the new parking garage.

The City is investigating the possibility of an additional Metro North rail station in the vicinity of the Route 1 overpass. This is an area that would benefit from redevelopment to higher residential and commercial densities. A new transit node midway between downtown and the Glenbrook and Springdale stations is one possibility, although capacity on the New Canaan branch line is limited. More attractive is a new station on the New Haven main line where new parking would intercept drivers who otherwise would have to go through downtown to get to the Transportation Center. Technical issues to be resolved include highway access, identifying a site capable of accommodating platforms for travel in both directions, track improvements (crossovers) and impact on travel times, line capacity and operating costs.

Because of the enormous expense of fixed-guideway systems (trolleys, light rail), Stamford is also working to maximize bus utility. This includes working to coordinate schedules with train arrivals and departures, a downtown shuttle and outfitting buses with bicycle carriers.

Employer/business shuttles and taxis are also a component of the overall transit strategy for destinations that cannot support public transit. To this end, Stamford is working to improve waiting areas and pick-up/drop-off areas for shuttles.

Finally, as demonstrated elsewhere in the region, ferries, under the right conditions can make a valuable contribution. Stamford continues to study ferry access to the West Channel, working with developers to make provisions for a landing as part of any redevelopment project.

PEDESTRIAN AND BICYCLE PROJECTS

Mobility, broadly conceived, includes not just facilitating automobile movement, but maximizing the full range of bicycling and pedestrian improvements. This has a multitude of benefits, not the least of which is improved health through active daily living. Some short term improvements are underway, such as providing bicycle racks at major trip generators and train stations. But Stamford is also planning a comprehensive bike-way and trailway network (reproduced in the Urban Design Report) linking neighborhoods to each other and to open spaces. In addition, wherever possible, new capital projects, such as the Stamford Urban Transit Way, include provisions for bicycles and a multitude of pedestrian improvements including sidewalks and intersection crossings. Some of the most important components of the bicycle and trailway network include a proposed loop around the harbor, providing much-needed access to the waterfront; a Merritt Parkway Trail; bicycle lanes on Magee Avenue; and a Mill River greenway extending from the South End to North Stamford.

PURPOSES AND METHODOLOGY

PURPOSES OF THE TRAFFIC AND TRANSIT STUDY

An increase in traffic congestion is one of the major concerns expressed whenever development in an area is considered. Stamford is no exception. To address traffic issues an estimate was made of future traffic conditions with the following purposes in mind:

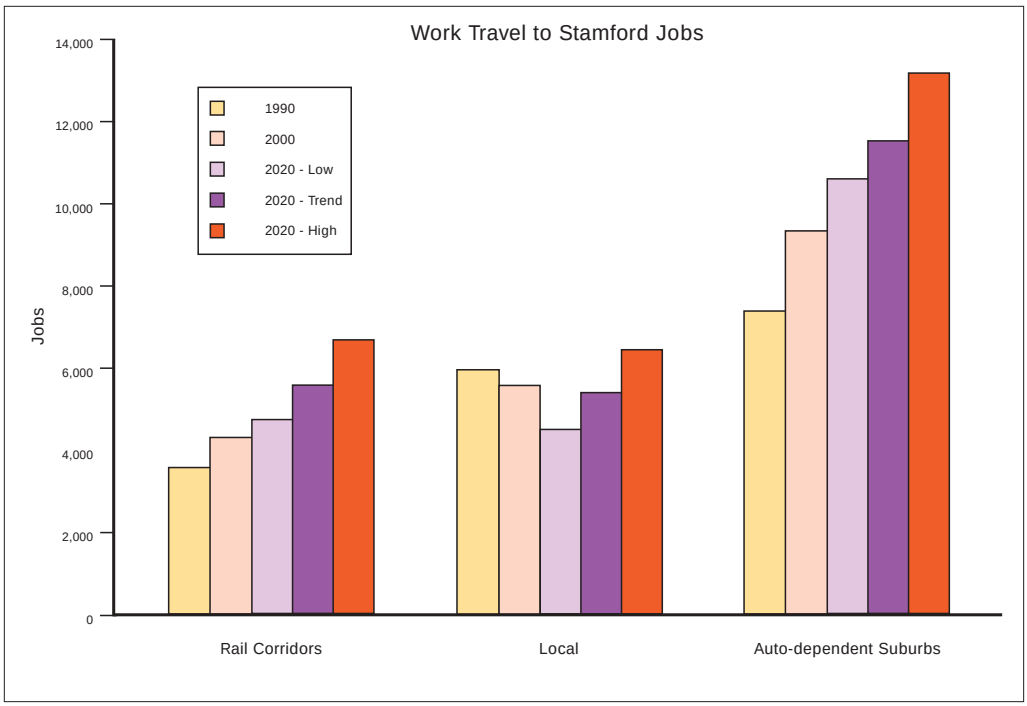
- to gain insights as to the relative level of traffic congestion among the three growth scenarios;
- to estimate the relative costs of traffic improvements within the City of Stamford of the growth scenarios;
- to understand the sources of traffic growth to assist in formulating the most appropriate measures to lower the impacts on traffic of each scenario;
- to highlight the appropriate agent or agents to carry out necessary traffic mitigation for each scenario; and
- to suggest how the Master Plan could be used to mitigate traffic impacts for each growth scenario.

CHANGING TRAVEL PATTERNS

Stamford workers are traveling longer and longer distances from places not serviceable by transit, causing significant increases in peak hour traffic particularly on the highways feeding Stamford.

The geographic pattern of residences among Stamford workers is changing. Examination of data from 1980 and 1990 revealed that an increasing number of workers were beginning their trip from home in distant suburbs, especially from northern Fairfield County, Litchfield County, and northern Westchester, and conversely, fewer were originating locally in Stamford or other parts of lower Fairfield County. These trends were assumed to continue to 2000[1] and beyond for the three growth scenarios. The implications for this trend on traffic are significant. The higher the proportion of work trips into Stamford that come from low density suburbs, the larger the share of these trips that will be made by automobile, with fewer in transit or on foot. To highlight this, Figure 1 stratifies the data by three types of origins –auto-dependent suburbs, local trips within Stamford, and from communities along the New Haven rail line in Connecticut and Westchester, and from The Bronx, and Manhattan. Figure 1 shows the huge increase in travel that can be expected from the auto-dependent suburbs, in the absence of any traffic mitigation measures. The auto-depen-

1. As of this writing the US Census Bureau has not processed or released the 2000 figures to confirm this trend, though there is no reason to believe that it has not continued.

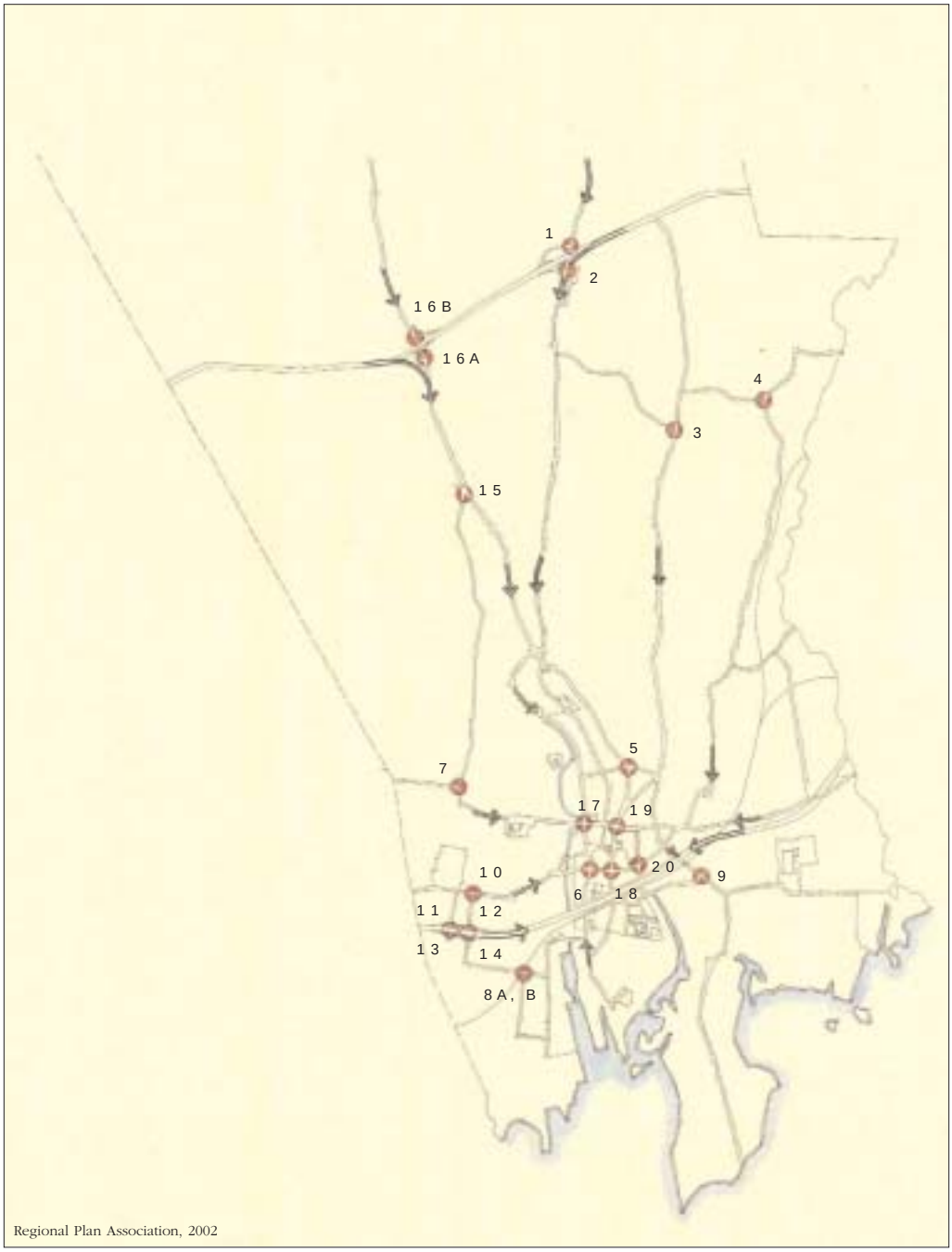


dent suburbs can be expected to grow about 50 percent under the high growth scenario. Growth can also be expected from the rail corridors, with little growth from local travel unless the patterns of housing among Stamford workers change.

METHODOLOGY:

To describe how traffic will be affected by different levels of growth in Stamford; and to describe how these effects can be mitigated, a three step process is used: First, the future traffic volumes created in each employment scenario are estimated at key auto entryways and representative intersections in Stamford. Second, the cost of making intersection improvements to handle the additional traffic volumes is estimated. Finally, the impact of various measures to reduce traffic volumes, and thus to reduce the costs of intersection improvements, is estimated.

To estimate the relative future traffic impacts in Stamford of each of the three growth scenarios, traffic volumes at representative intersections were estimated for the morning peak hour. Since travel to work represents the bulk of auto travel at this time of day, the geographical distribution of Stamford's workers home locations was used as the building block to estimate morning traffic. This geographic pattern was projected for the forecast year of 2020, accounting for the share of these workers who could be expected, in the absence of major changes, to travel to work by automobile. The volume of peak hour traffic was assigned first to 20 entryways into Stamford, then to the major roadways in the City, and finally to the approaches to 22 representative intersections (the list of these intersections is included in Appendix A). Once this assignment of traffic was accom-



Regional Plan Association, 2002

Major Auto Entryways to Stamford

Auto Entryways

Representative Critical Intersections

plished, it was possible to estimate the traffic "level of service" [see box] at each of these intersections and to determine what improvements would be necessary to bring the level of service to an acceptable standard for congestion relief. The range of intersection improvements included:

- prohibition of parking;
- more green time for one direction of traffic;
- provision of a turning phase in the traffic signal;
- prohibition of turning movements;
- re-assignment of approach lanes to allow only certain movements on those lanes;
- widening of the approach to the intersection; and
- addition of one or more turning lanes.

To provide a relative indicator of the impact of each growth scenario, the costs for these necessary improvements at each intersection to attain the standard level of service were estimated and then totaled for all 22 intersections to yield a relative cost for traffic improvements for each scenario.

MITIGATION STRATEGIES

Three kinds of mitigation measures are described: transportation demand management, transit improvements and more housing for workers in Stamford.

Once these intersection costs were estimated the exercise was repeated for various packages of mitigation measures designed to reduce the volume of traffic. These measures fall into three categories including transportation demand management (TDM), transit improvements, and housing shifts for Stamford workers.

TDM measures are actions that would induce single-occupant auto travelers to travel in the off-peak, share a ride, or not make the trip at all. TDM measures were further subdivided into measures that are:

a) primarily the province of employers including:
   - flextime and other alternative work schedule measures such as flex-time, four-day work weeks or staggered hours;
   - telecommuting;
   - guaranteed ride home programs to give those who use transit or carpool an option if they must go home in an emergency or work late;
   - carpool and vanpooling matching; and
   - commuter choice programs which involve tax-incentive subsidies for using transit.

It is assumed that a reasonable employer participation in these programs could reduce peak hour single-occupant driving by 10 percent.

b) more aggressive measures that require either significant land use changes or other public policies "outside the box". These include:

- lower maximum or mandated lower parking ratios to discourage single-occupant driving;
- lower parking ratio requirements near train stations and higher floor area ratios near transit stations to encourage transit use where it is most attractive;
- cashing out of free parking to give those who don't drive a subsidy equivalent to the free parking subsidy for those that do;
- transfer of development rights to lower development away from transit and increase development near transit; and
- location efficient mortgages to encourage households to buy in areas near transit.

For the purpose of the traffic intersection cost analysis, it was assumed that these policies would lower single-occupant driving by 20 percent. Most of these measures can be implemented through changes in zoning or land use ordinances that could be part of the Master Plan.

Transit improvements account for the second strategy that could reduce peak hour traffic. These include both bus and rail actions that would lower fares, increase the frequency of service and expand it to earlier in the morning or later in the evening, adequate parking at the boarding points, more timely connections between train and bus service, easier walking environments on the approaches to stops, and finally, greater amenity at stations and stops, including seating, shelter from the elements, more complete transit information, and better lighting. Specific actions include:

- lower reverse rail fares from New York and for intra-Connecticut travel;
- more peak period service in the peak and in the "shoulders of the peak, especially in the evening after 6 pm;
- added and better timed feeder service to and from the Stamford station;[2] and
- added parking at stations north and east of Stamford.

The impact of more housing in Stamford for Stamford workers was also examined. The logic is simple. If more of Stamford's workers do not have to travel long distances, then they will occupy less road space. And if they can be located in places where they are more likely to use transit or walk to work, then traffic volumes would be lower. To estimate the amount of potential additional housing, build-out of major redevelopment projects such as Mill River, Dock Street, Northeast Utilities, and Yale & Towne were assumed. To that was added the potential housing from proposed housing projects, soft sites and in-fill in and around the downtown, and redevelopment of several large industrial sites outside downtown. Taken together, these yielded a potential for 8,000 dwelling units. Added to this was the approximate level of in-fill growth in the last 13 years of 2,000 units, giving a total of 10,000 possible new units, which is consistent with the projections for the high growth scenario.

The likely impacts of each of these three mitigation strategies – TDM, transit, and housing – on the cost of intersection improvements for each of the three growth scenarios were made. These

2. An analysis of the bus and rail schedules at the Stamford Transportation Center revealed the majority of the trains did not meet the bus service with reasonable timing, defining that as from two to nine minutes before the train left of after it arrived. Expanded service would be needed, including an additional bus for the service and expanded service earlier and late in the peak period.

impacts were tested acting alone and in concert with one another, since there is no reason to select one category to the exclusion of the other two. The results are described in the Key Findings section.

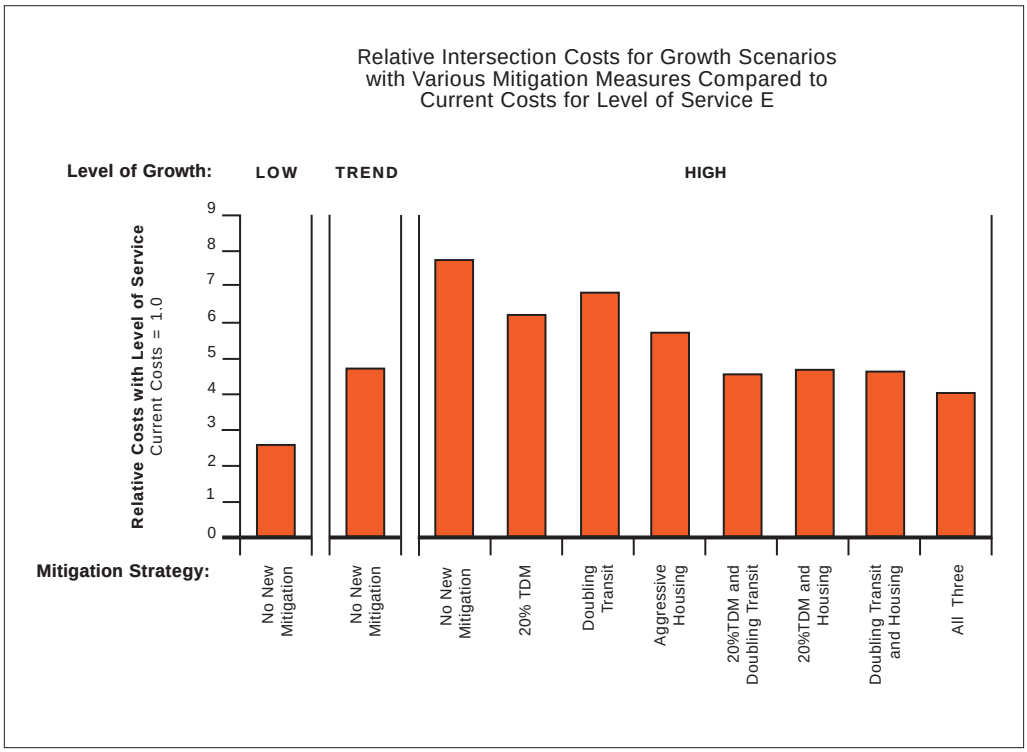
A fuller explanation of the traffic estimating procedures is presented as Appendix B.

FINDINGS

THE RELATIVE COST OF UNCLOGGING STAMFORD'S INTERSECTIONS:

Without measures to reduce traffic volumes, the costs to unclog Stamford's intersections will double even in the low growth scenario. However, the least aggressive TDM measures can reduce traffic costs significantly. Further, if any two of the three categories of mitigation measures are pursued (TDM, more transit, more housing), the cost impact of even the high growth scenario can be lowered to the impact of the low growth scenario.

The strain on the streets of Stamford will grow, whether the growth is low and slow or high and more rapid. To understand the impacts of each growth scenario and of measures to mitigate traffic impacts, cost estimates were made for improving a set of representative intersections in the City to allow traffic to reach an acceptable level. Figure 2 shows this cost indicator in relative terms, with the current cost of bringing the intersections to Level of Service (LOS) E, set at 1.0. Note that if LOS of D is desired, then the cost to upgrade the intersections today would rise by about 40



percent. In the second, third and fourth sets of bars the relative cost of intersection improvements is shown with no mitigation assumed. Even then, the costs for the low growth scenario will increase by almost two times, and if the higher LOS of D is sought, costs would need to increase by almost three times. With the trend and high growth scenarios, costs would naturally be much higher, reaching over five times the costs with the high growth scenario, assuming LOS of E was acceptable.

What if the traffic volumes could be lower? How much difference would it make in the cost of intersection improvements? In the fifth set of bars the costs are shown if it were possible for TDM to reduce auto traffic by 10 percent for the trend growth scenario. The relative cost of bringing the intersections to LOS E would drop from three times to two times today's costs. With LOS D, they would drop from just under five times to about 3.7 times current costs.

The remaining sets of bars display the relative intersection costs for the high growth scenario if a variety of mitigation measures are put in place. The first three sets alternatively test the 20 percent TDM (assuming many of the "out of the box" concepts), a substantial growth in transit use, and finally, the addition of 10,000 housing units within the City of Stamford. Each alone has a similar impact, lowering the relative costs from about five to four times the costs for LOS E and from eight to about six times the costs for LOS D. The next three sets of bars shows the impact of combining two of these three mitigation strategies; this lowers the impact to about three times today's costs. Finally, when all three traffic mitigation strategies are tested, the costs drop to about 2 _ times current costs for LOS E and just under four times for LOS D.

What do we learn from this theoretical exercise? That economic growth will impact negatively traffic is hardly news. But it is possible to dampen the impact of traffic and the costs of fixing it to a considerable degree through a set of deliberate public policy decisions, aggressively pursued. Consider Figure 2 slightly differently. If a relatively modest 10 percent drop in traffic could be achieved through employer-sponsored programs, the cost of a trend growth scenario would hardly be higher than the cost of a low growth scenario. Put another way, if employers of Stamford are willing to take on a TDM program, then the City of Stamford can grow according to trends, and enjoy the traffic impacts associated with slow growth. Similarly, the traffic impacts of the High Growth scenario can be reduced to those of the Trend Growth scenario if two of the three sets of mitigation strategies are advanced. Further, high growth would have the traffic impact of low growth if all three strategies were pursued.

What if the mitigation strategies are not pursued? Without the mitigation strategies, trend growth, and even more so, high growth would only function with substantial expansion of intersections. For example, the high growth scenario would require a total of more than half of the intersections studied to be widened to some degree, in some cases adding new turning lanes at the expense of the sidewalk. The effect would be a further disintegration of the walking scale of the City's downtown, turning it further into a high-density, auto-oriented, suburban-like city.

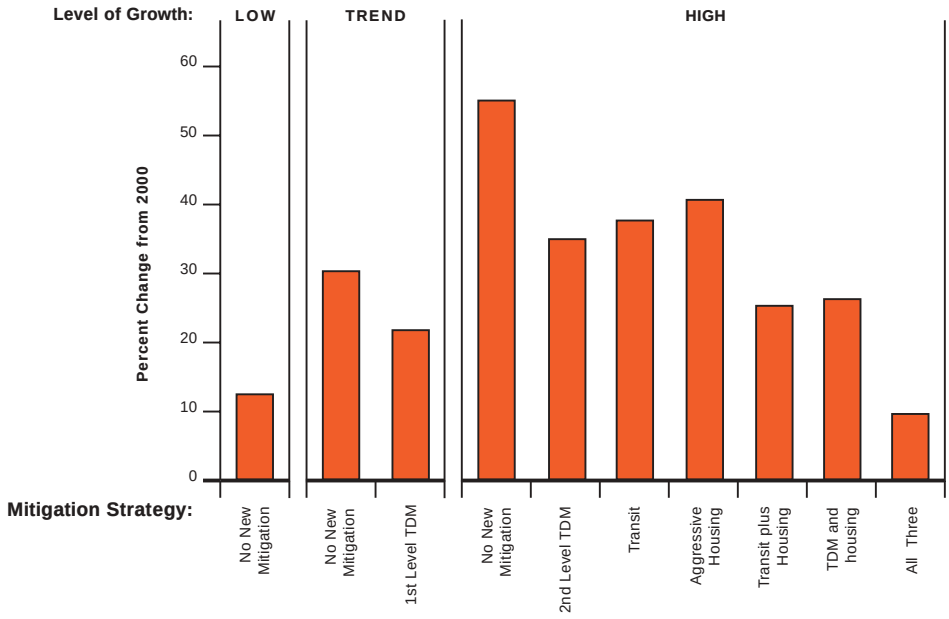
THE MERRITT AND I-95 TRAFFIC PROBLEM

The low trend and high growth scenarios will add respectively 12, 30 and 55 percent to highway traffic entering Stamford. However, more housing in Stamford, combined with aggressive Transit Demand Management measures and more transit can bring the increased traffic from the highways created by high growth down to the levels associated with low growth.

What are the impacts on the two major highways of the growth scenarios, with and without the traffic mitigation strategies? In Figure 3 the volume of traffic to work in Stamford is shown relative to current volumes for only the portion of traffic likely to use either the Merritt Parkway or Interstate 95 to reach their jobs. The low scenario is expected to add only about 12 percent to the traffic growth leaving these two highways, but the trend and high growth scenarios would add 30 percent and 55 percent, respectively.

The trend growth in traffic could be dampened with an employer-based TDM program that would lower traffic volumes somewhat, but still keep them above the low growth levels. The high growth

Growth in Vehicles Leaving Two Major Highways to Travel to Work in Stamford
Three 2002 Growth Scenarios



scenario, with its growth in exiting traffic from these two major highways is clearly in need of some reductions; a 55 percent growth in traffic is certainly not going to be sustainable. How do the mitigation strategies affect this traffic growth? As can be seen in Figure 3, the aggressive TDM and transit strategies each can lower traffic volumes so that growth falls to only somewhat about the trend growth levels – about 30 percent. But the housing strategy can have substantial greater affect, bringing the growth in traffic exiting the highways to above a 20 percent growth level. This happens because a substantial greater number of Stamford workers would be living within Stamford if the housing supply in the City were expanded, making travel on the Merritt and I-95 unnecessary. As can be seen from Figure 3, any mitigation package including housing would have a significant impact on traffic. Indeed, the housing strategy coupled with either TDM or transit can lower the traffic growth to levels below the growth associated with low growth, and if combined with both, traffic volumes might even drop from today's levels! Put another way, a policy that appreciably expands housing in Stamford can make it possible for Stamford's economy to grow without major traffic repercussions on or exiting the Merritt Parkway or Interstate 95.

POLICY IMPLICATIONS

In the absence of significant changes in the residential locational decisions by Stamford's workers, the trend to toward more distance and exurban locations, will worsen traffic on Stamford's streets and on the Merritt Parkway and Interstate 95.

To lessen these traffic impacts, a combination of strategies would need to be followed, including transportation demand management (TDM), significant transit improvements, and the introduction of substantial new housing in areas close to the downtown.

Even under circumstances of lower growth, the intersections of Stamford will see growing traffic necessitating added costs of construction, which will reduce the walkability in the City and particularly in the downtown. To prevent this, Stamford must actively work with employers to institute employee policies in the areas of flextime, telecommuting, guaranteed rides home and transit supporting commuter choice programs. A close working relationship with Metropool, the organization designed to promote these activities and headquartered in Stamford, should be established to accomplish this.

To reduce the impacts on local traffic while continuing to grow even at a trend level, the City of Stamford must promote an aggressive policy of TDM, which includes changes in zoning that lower parking ratios, differentiate parking ratios and floor-area ratios to favor areas near transit, and enable transfer of development rights. Each of these can be codified within the Master Plan.

A variety of improvements in public transit can eat into the growth of traffic. The City of Stamford should work with ConnDOT, Metro North and Connecticut Transit to aggressively promote transit. Actions to be taken include added parking at stations east of Stamford, lower New Haven line

fares, added bus service to meet trains at the Stamford Transportation Center, and additional train service, particular in the early evening after traditional peak hours.

The expansion of housing in Stamford is a traffic mitigation strategy totally under the control of the City. Housing expansion will not only help control the growth of traffic on City streets, but will lessen the pressures on the state's highway network, including the badly congested Merritt Parkway and Interstate 95.

To sustain economic growth will require accompanying actions to limit traffic growth. To the extent that housing, TDM and transit actions are stymied, traffic in Stamford's streets would need to be accommodated by ill-advised street expansion that would further reduce the attractiveness of Stamford's streets.

OTHER POLICY IMPLICATIONS OF THE MITIGATION MEASURES

The benefits of these three traffic mitigation strategies extend beyond traffic in Stamford. Effective TDM measures would have a positive impact on traffic outside the City to the highways that now deliver vehicles to the City: the Merritt Parkway and Interstate 95. TDM can lower individual costs as carpoolers, telecommuters, and those working fewer days leave their cars in their driveways. And those who shift to the off-peak encounter less stressful driving.

The land use related TDM measures could have major effect on the urban landscape of Stamford. Fewer garage spaces can only mean a better-looking more productive downtown. Transit riders, both existing and newly converted, would have shorter walks to their jobs. And all TDM measures have the potential to increase transit use, thereby adding pressure for more service, which, in turn, would make transit still more attractive.

The strategy package of improved transit would not only have the intrinsic benefits to the new riders – why else would they convert to transit if they did not find it more attractive – but could translate to benefits for current transit riders, including more frequent and wider spanning services and lower costs.

The housing mitigation strategy may have the most wide-ranging advantages. A greater housing supply within Stamford would lower housing costs, lower the cost of commuting, shorten the walk to transit, offer a greater variety of housing choices, and stem the blight of under-used close-in tracts of land.

Taken together, high economic growth coupled with the mitigation strategies can result on a more livable community, with the economic growth fueling prosperity and the mitigation strategies making the prosperity livable from a traffic and pedestrian perspective.

POLICY SUMMARY

SUMMARY MITIGATION and POLICY TABLES

First Level Transportation Demand Management Strategies - Employer-based Strategies

Strategy	*Challenges*	*Advantages*	*Implementing Entity*
Alternative work schedules	Productivity concerns; works against carpooling/transit; requires widespread adoption to be effective	Employee benefits without higher costs; many employee favor; two-worker households more flexible; no public sector costs	Employer
Telecommuting	Fear of loss of control by managers; workers feel out of touch; works against carpooling transit; employer may save on office space; requires widespread adoption to be effective	Employees tend to be more productive; employer equipment costs; no public sector costs	Employer
Guaranteed ride home	Initial concerns about cost; requires widespread adoption to be effective	Strengthens carpooling/transit; no public sector costs	Employer
Commuter Choice program	Administrative burden for employers; requires widespread adoption to be effective	Tax gains for employers/employees; add transit riders; Metropool program in place; no public sector costs	Employer
Carpool matching	Administrative burden for employers; driving alone preferences; requires widespread adoption to be effective	No public sector costs	Employer

Mitigation Findings

- Brings traffic impacts for low growth part way to current levels
- Brings traffic impacts for trend growth part way to low growth levels
- Has only marginal impact on high growth traffic

Performance goals:

- Half of all downtown employers with more than 100 employees to institute two or more of above strategies.

Second Level Master Plan Transportation Demand Management Strategies			
Strategy	*Challenges*	*Advantages*	*Implementing Entity*
Cashing out of free parking	Difficult concept to get across; parking costs paid for and cannot be recovered; low public cost	Major impact on reducing single-occupant driving; levels playing field for non-SOVs	City and employers
Lower maximum or mandate lower parking ratios	Not retroactive; may drive employees away if no place to park	Reduces cost to developers; can shift resources to other amenities; reduces unnecessary building bulk: reduces garage blight; no public costs	City
Lower parking ratios required near transit	Difficult to calibrate; resistance from lending institutions	Encourages carpooling and transit; saves costs to developers	City
Higher floor area ratios near transit	May create unwanted building bulk and height; need to devise bonus system carefully	More passive approach than variable parking ratios; encourages development where transit use is likely to be higher; offers imaginative urban design possibilities	City
Transfer of development rights	Difficult to implement; may be inequitable	Shifts development where transit use likely to be higher;	City

Mitigation Findings

- With transit can bring high growth scenario to below trend highway impacts
- With housing and transit can bring high trend impacts below current levels and just above low growth scenario at intersections

Performance goals:

- All new office space in downtown subject of one or more of the aggressive TDM strategies.

Transit Strategies

Strategy	*Challenges*	*Advantages*	*Implementing Entity*
Lower rail fares	May lose revenues for Metro North and State; limited by "hold-down"* problem	Has added riders and revenues in past	State, Metro North
Add peak and evening trains	Costly; may not be able to operationally; requires added rolling stock	Makes transit more convenient	Metro North, State
Better bus connections at rail stations	Costly; limited ridership potential	Makes transit more attractive	Connecticut Transit
Add parking along New Haven line	Resistance by local communities; if at new stations may slow rail service; adds local traffic congestion	Can unblock today's constraints to ridership growth	Towns, Metro North, developers
Increase bus service in denser areas	Higher public subsidies for transit	Increases transit use	

* If the intra-state fare is set too low, riders can"cheat the system" by purchasing one ticket at the intra-state fare plus an additional ticket at the fare from Stamford to New York at a lower total price.

Mitigation Findings

- Brings traffic impacts lower, but not significantly on its own.
- With aggressive TDM can bring high growth scenario to below trend highway impacts
- With housing and TDM can bring high trend impacts below current levels and just above low growth scenario at intersections

Performance goals:

- More than 75% of all bus-rail meets 2 to 9 minutes
- Addition of 20% to parking supply on NH line
- No more than 30 minute gap in evening from Stamford north
- No more than 20-minute gap in peak periods
- No increase in transit fares relative to cost of living

Housing Strategies			
Strategy	*Challenges*	*Advantages*	*Implementing Entity*
Locate all multi-family housing within 1/4 mile of bus route or 1/2 of downtown	Making it attractive to all income groups; making design attractive; limiting housing development in places that do not qualify	Increases transit use; saves land in lower density areas; lowers auto use; increases walking and biking; lowers highway traffic volumes	City
Increase bus service in denser areas	Higher public subsidies for transit	Increases transit use	Connecticut Transit, State of Connecticut
Increase housing density to at least 7 dwellings per net residential acre	Designing at these densities to make housing attractive	Increases transit use; saves land in lower density areas; lowers auto use; increases walking and biking; lowers highway traffic volumes	City

Mitigation Findings

- Largest single impact on highway traffic; with either aggressive TDM or transit, can bring traffic to low scenario levels.
- With housing and transit can bring high trend impacts below current levels and just above low growth scenario at intersections

Performance goals:

- Increase bus use by 50%
- 80 percent of new housing in Stamford within walk of downtown or within 1/4 walk of bus route.

APPENDIX A

PROCEDURE FOR ESTIMATING INTERSECTION IMPACTS FOR GROWTH SCENARIOS

1. Establish commutersheds for commuters into Stamford Central Business District (CBD) corresponding to entryways.
2. Determine the distribution for these commutersheds and the mode shares for them based on the 1990 US Census work trip pattern.
3. Compare the 1980 and 1990 county to county work trip patterns to determine the long-term shift for the sheds.
4. Apply the shift from 1980 to 1990 to estimate the commutershed pattern for 2000.
5. Factor the mode shares from each commutershed to reflect changes toward higher rail shares observed on Metro North in the 1990s.
6. Expand the 2000 base work trips by shed to 2020 for each of the three growth scenarios.
7. Assume the mode shares for each entryway to be the same as for 2000 for the base conditions for the three growth scenarios
8. For trend and high growth scenarios C apply TDM improvements equivalent to a reduction in single-occupancy driving of 10 and 20 percent respectively.
9. For the global growth scenario assume that transit use doubles in share.
10. Determine the likely growth in housing within Stamford based on available land and calculate the estimate share of workers in the housing increment that are likely to work in Stamford.
11. For each scenario and for each traffic mitigation assumption for that those scenarios, determine the percent change in traffic volumes for each entryway for work trips into Stamford CBD from the 2000 base condition.
12. Combine entryway percentages to account for merging of more than one entryway, e.g., High Ridge and Long Ridge Roads at Bulls Head.
13. Estimate the percentage of each combined entryway that will carry work trip-CBD bound traffic in the peak hour.
14. Assume that the percent growth in the non-work or non-CBD trips will be equal to the overall growth assumed for Fairfield County of 18.1%, 17.8% and 17.6 % for the slow, trend and high growth scenarios, respectively.
15. Calculate the traffic growth percentages for each combined entryway for each of the scenario-mitigation combinations by applying the work trip growth, the non-work, non-CBD growth (step 13) and the proportion of each (step 12).

16. For each of the movements at each of the 22 intersections being examined determine the appropriate combined entryway growth rates to be used. In some cases, combining percentages was necessary.
17. Apply these growth rates to current traffic counts to calculate the level of service in the morning peak hour for each of 22 intersections.
18. For each growth scenario-mitigation combination, determine the minimal improvements necessary at each intersection to achieve both LOS D and LOS E.
19. Estimate the cost of these improvements and total them for all 22 intersections.

TRAFFIC LEVELS OF SERVICE (LOS)

Traffic engineers have developed standards for measuring the extent of congestion on streets and highways, and given them letter grades A to F, defining the levels of service (LOS). The LOS for intersections are described below:

- LOS A describes operations with very low delay, i.e., less than 5.0 seconds per vehicle. This occurs when signal progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all.
- LOS B describes operations with delay in the range of 5.1 to 15.0 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. Again, most vehicles do not stop at the intersection.
- LOS C describes operations with delay in the range of 15.1 to 25.0 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- LOS D describes operations with delay in the range of 25.1 to 40.0 seconds per vehicle. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volume-to-capacity (v/c) ratios. Many vehicles stop, and the proportion of vehicles not stopping declines.
- LOS E describes operations with delay in the range of 40.1 to 60.0 seconds per vehicle. This is considered the upper limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high volume-to-capacity ratios.
- LOS F describes operations with delay in excess of 60.0 seconds per vehicle. This is considered unacceptable to most drivers. This condition often occurs with over-saturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high volume-to-capacity ratios with cycle failures. Poor progression and long cycle lengths may also be contributing to such delays. Often, vehicles do not pass through the intersection in one signal cycle.
- For this report, intersections were improved to LOS D, i.e. improvements were added to the intersection until all movements operated at a mid-LOS D delay level (approximately 32.5 seconds). Similarly, for intersections improved to LOS E, improvement measures were added to the intersection until all movements operated at a mid-LOS E delay level (approximately 50 seconds of delay per average vehicle).

APPENDIX B

INTERSECTIONS USED IN TRAFFIC ANALYSIS

Number	*Intersection*
1	High Ridge Road @ Merritt Parkway WB Ramps
2	High Ridge Road @ Merritt Parkway EB Ramps
3	Newfield Avenue @ Vine Road
4	Hope Street @ Weed Hill Avenue
5	Bedford Street @ Hoyt Street
6	Washington Boulevard @ Tresser Boulevard
7	Stillwater Road @ Palmers Hill Road
8A	Fairfield Avenue (East) @ Selleck Street
8B	Fairfield Avenue (West) @ Selleck Street
9	Elm Street @ Jefferson/Myrtle
10	West Avenue @ West Main Street
11	Harvard Avenue @ Grenhart Road
12	West Avenue @ Grenhart Road
13	Harvard Avenue @ Waverly Place
14	West Avenue @ Waverly Place
15	Long Ridge Road @ Stillwater Road
16A	Long Ridge Road @ Merritt Parkway EB
16B	Long Ridge Road @ Merritt Parkway WB
17	Washington Boulevard @ Broad Street
18	Atlantic Street @ Tresser Boulevard
19	Bedford/Atlantic @ Broad Street
20	Canal/Greyrock @ Tresser Boulevard

APPENDIX C

APPENDIX: SUMMARY OF BUS/RAIL CONNECTION OPPORTUNITIES

Summary of Bus/Rail Connection Opportunities
Current and Proposed

	Morning from NY	Morning from New Haven	Afternoon to NY	Afternoon to New Haven	Total	Percent "Meets"
Central Route						
Number of Trains	11	17	12	17	57	
"Meets" Now	7	15	4	6	32	56
Recommended	7	15	12	16	50	88
Bulls Head Route						
Number of Trains	11	17	12	17	57	
"Meets" Now	0	2	4	3	9	16
Recommended	9	11	9	12	41	72

Recommendations:

Central Route

Operate two buses for the Central route and extend services to 3:38pm - 6:48pm.
No change in morning.

Bulls Head Route

Operate two buses in both morning and afternoon.
Expand services in morning to 6:50am - 9:20am and afternoon to 3:51pm - 6:51pm.

Conclusion: Added service almost doubles trains with favorable bus connections.

APPENDIX: AVAILABLE SEATING ON NEW HAVEN LINE

Available Seating on the New Haven Line
Morning Peak Period Prior to Stamford

Terminal Station	Seats Occupied	Total Seats	Seats Available	Offs in Stamford	Arrival time in Stamford	Stations Served
New Haven	542	688	146	70	6:55am	New Haven to South Norwalk
South Norwalk	541	814	273	6	7:07am	South Norwalk to Noroton Hts.
New Haven	696	920	224	199	7:19am	New Haven to Fairfield, South Norwalk
South Norwalk	684	960	276	12	7:38am	South Norwalk to Noroton Hts.
New Haven	400	928	528	140	7:48am	New Haven to South Norwalk
New Haven	720	842	122	136	8:09am	New Haven to South Norwalk
New Haven	344	814	470	177	8:15am	New Haven to Fairfield
Bridgeport	430	696	266	44	8:31am	Bridgeport, Fairfield, Westport-Noroton Hts.
New Haven	270	582	312	103	8:42am	New Haven to Fairfield
South Norwalk	224	582	358	7	9:05am	South Norwalk to Noroton Hts.
New Haven	314	582	268	43	9:11am	New Haven to Noroton Hts.

Available Seats Arriving in Stamford from Points East equals 3,243.

Current Rail Passengers Disembarking in Stamford: 937.

Conclusion: Ample Room for Additional Riders to Stamford from Points East

Number of Trains With Seats Stopping at Each Station
Morning Peak Period

Station	Number of Stops
New Haven	7

Percent Distribution of Residents of Workers in Stamford

	1980 (actual)	1990 (actual)	2000 (estimated)	Implications
Southwestern CT	70.9	64.9	58.9	Proportionately fewer local trips to Stamford CBD
Rest of CT	19.9	24.6	29.4	More trips from auto-dependent suburbs mostly using MP
Westchester	5.5	6.4	7.4	More trips from auto-dependent suburbs using I-95 or MP
Manhattan	0.7	0.6	0.6	Market limited to remove autos from road
Four NYC Boroughs	1.2	1.3	1.4	Market limited to remove autos from road
Hudson Valley East	0.4	0.7	0.9	More trips from auto-dependent suburbs using local roads or MP
West of Hudson	1	1.1	1.2	Limited potential for public transit via I-287 corridor
Long Island	0.4	0.4	0.3	Limited market for new transit

Conclusion: Residential Location of Stamford Workers are Shifting to More Distant and Auto Dependent Areas

APPENDIX: TRAFFIC MITIGATION COST ASSUMPTIONS

Mitigation to LOS D

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
1	High Ridge Road @ Merritt Parkway WB Ramps	n.a.	n.a.	n.a.	• Widen the EB approach from two to three lanes by providing one left-turn lane and two right-turn lanes. ($20 - $30,000)	n.a.	n.a.	• Widen the EB approach from two to three lanes by providing one left-turn lane and two right-turn lanes. ($20 - $30,000)	• Widen the EB approach from two to three lanes by providing one left-turn lane and two right-turn lanes. ($20 - $30,000)	n.a.
		er = $0	er = $0	er = $0	er = $20,000 - $30,000	er = $0	er = $0	er = $20,000 - $30,000	er = $20,000 - $30,000	er = $0
2	High Ridge Road @ Merritt Parkway EB Ramps	• Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500
3	Newfield Avenue @ Vine Road	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
4	Hope Street @ Weed Hill Avenue	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
5	Bedford Street @ Hoyt Street	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
6	Washington Boulevard @ Tresser Boulevard	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Widen the SB and EB lanes to from 10 and 11 feet to 12 feet. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Widen three approaches from 10- and 11-foot to 12-foot lanes. ($30 - $45,000) • Widen the SB approach from four to five lanes by providing a second left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $20,700 - $32,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $50,700 - $77,500	er = $700 - $2,500
7	Stillwater Road @ Palmers Hill Road	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
8A	Fairfield Avenue (East) @ Selleck Street	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
8B	Fairfield Avenue (West) @ Selleck Street	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500

Mitigation to LOS D

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
9	Elm Street @ Jefferson/Myrtle	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the EB lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20 - $30,000) • Widen two approaches from 10 to 12-foot lanes. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the EB lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20 - $30,000) • Widen WB approach lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20 - $30,000) • Widen two approaches from 10 to 12-foot lanes. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20 - $30,000) • Widen the NB approach from two to three lanes by providing a left-turn lane. ($20 - $30,000) • Widen the WB approach lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20 - $30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20 - $30,000) • Widen the NB approach from two to three lanes by providing a left-turn lane. ($20 - $30,000) • Widen WB approach lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)
		cr = $20 - $30,000	*cr* = $20 - $30,000	*cr* = $30,700 - $47,500	*cr* = $60,700 - $92,500	*cr* = $30,700 - $47,500	*cr* = $50,700 - $77,500	*cr* = $60,700 - $92,500	*cr* = $70,700 - $107,500	*cr* = $50,700 - $77,500
10	West Avenue @ West Main Street	• Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Prohibit NB and SB left-turns. • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Prohibit SB left-turns. • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Prohibit SB left-turns. • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Prohibit SB left-turns. • Provide an exclusive WB phase. • Widen the eastbound approach from two to three lanes by adding a right-turn lane within the parking lane. ($20 - $30,000) • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)
		cr = $700 - $2,500	*cr* = $2,700 - $4,500	*cr* = $2,700 - $4,500	*cr* = $2,700 - $4,500	*cr* = $2,700 - $4,500	*cr* = $2,700 - $4,500	*cr* = $2,700 - $4,500	*cr* = $22,700 - $34,500	*cr* = $2,700 - $4,500
11	Harvard Avenue @ Grenhart Road	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		cr = $0	*cr* = $0	*cr* = $0	*cr* = $0	*cr* = $0	*cr* = $0	*cr* = $0	*cr* = $0	*cr* = $0
12	West Avenue @ Grenhart Road	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Widen the NB lanes from 11 to 12 feet. ($10,000 - $15,000) • Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000)
		cr = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $4,700 - $6,500	*cr* = $700 - $2,500	*cr* = $4,700 - $6,500	*cr* = $4,700 - $6,500	*cr* = $14,700 - $21,500	*cr* = $4,000
13	Harvard Avenue @	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Mitigation to LOS D

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
13	Waverly Place	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
14	West Avenue @ Waverly Place	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
15	Long Ridge Road @ Stillwater Road	• Reduce cycle length and green time shift. ($700 - $2,500)	• Reduce cycle length and green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Reduce cycle length and green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $20,700 - $32,500	er = $700 - $2,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $700 - $2,500
16A	Long Ridge Road @ Merritt Parkway EB	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $700 - $2,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $700 - $2,500
16B	Long Ridge Road @ Merritt Parkway WB	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
17	Washington Boulevard @ Broad Street	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen the NB and SB approaches lanes from 10 to 12 feet. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen all approach lanes from 10 to 12 feet. ($40 - $60,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Widen three approaches from 10 to 12-foot lanes. ($30 - $45,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen all four approach from 10 to 12-foot lanes. ($40 - $60,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Widen three approaches from 10 to 12-foot lanes. ($30 - $45,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Widen three approaches from 10 to 12-foot lanes. ($30 - $45,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Widen three approaches from 10 to 12-foot lanes. ($30 - $45,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from four to five lanes by adding a third through lane. ($20 - $30,000) • Widen three approaches from 10 to 12-foot lanes. ($30 - $45,000) • Green time shift. ($700 - $2,500)
		er = $4,700 - $6,500	er = $24,700 - $36,500	er = $44,700 - $66,500	er = $50,700 - $77,500	er = $44,700 - $66,500	er = $50,700 - $77,500	er = $50,700 - $77,500	er = $50,700 - $77,500	er = $50,700 - $77,500

Mitigation to LOS D

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
18	Atlantic Street @ Tresser Boulevard	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)
		cr = $8,700 - $10,500	cr = $8,700 - $10,500	cr = $28,000 - $38,000	cr = $28,700 - $40,500	cr = $8,700 - $10,500	cr = $28,700 - $40,500	cr = $8,700 - $10,500	cr = $28,700 - $40,500	cr = $8,700 - $10,500
19	Bedford/Atlantic @ Broad Street	n.a.	n.a.	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)
		cr = $0	cr = $0	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500
20	Canal/Greyrock @ Tresser Boulevard	n.a.	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		cr = $0	cr = $0	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500	cr = $700 - $2,500
	No Mitigation	8	6	4	3	4	4	3	3	4
	Signal Timing Mitigation	11	13	13	10	15	11	12	8	15
	Widening or Major Mitigation	3	3	5	9	3	7	7	11	3

Mitigation to LOS E

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
1	High Ridge Road @ Merritt Parkway WB Ramps	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
2	High Ridge Road @ Merritt Parkway EB Ramps	n.a.	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Widen the SB approach from two to three lanes to include an exclusive left-turn lane. ($20 - $30,000) • Green time shift. ($700 - $2,500)
		er = $0	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500	er = $20,700 - $32,500
3	Newfield Avenue @ Vine Road	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
4	Hope Street @ Weed Hill Avenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
5	Bedford Street @ Hoyt Street	n.a.	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Eliminate the exclusive WB phase to provide an exclusive EB phase. • Green time shift. ($700 - $2,500; covers both measures)
		er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
6	Washington Boulevard @ Tresser Boulevard	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Widen the SB lanes to from 10 and 11 feet to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $10,700 - $17,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
7	Stillwater Road @ Palmers Hill Road	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
8A	Fairfield Avenue (East) @ Selleck Street	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
8B	Fairfield Avenue (West) @ Selleck Street	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500

Mitigation to LOS E

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
9	Elm Street @ Jefferson/Myrtle	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20-30,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20-30,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20-30,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20-30,000) • Green time shift. ($700 - $2,500)	• Widen the EB approach from two to three lanes by adding a second left-turn lane. ($20-30,000) • Widen the SB approach from two to three lanes by adding a left-turn lane. ($20-30,000) • Green time shift. ($700 - $2,500)
		er = $20 - $30,000	er = $20 - $30,000	er = $20 - $30,000	er = $40,700 - $62,500	er = $20 - $30,000	er = $40,700 - $62,500	er = $40,700 - $62,500	er = $40,700 - $62,500	er = $40,700 - $62,500
10	West Avenue @ West Main Street	• Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Prohibit SB left-turns. • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)	• Prohibit parking on the EB and WB approach. ($2,000) • Provide an exclusive WB phase. • Green time shift. ($700 - $2,500; covers both signal improvement measures)
		er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $2,700 - $4,500	er = $700 - $2,500	er = $2,700 - $4,500	er = $2,700 - $4,500	er = $2,700 - $4,500	er = $2,700 - $4,500
11	Harvard Avenue @ Grenhart Road	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
12	West Avenue @ Grenhart Road	n.a.	n.a.	• Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the WB approach from one left-turn lane, one through lane, and one shared through/right-turn lane to two left-turn lane and one shared through/right-turn lane. ($4,000)
		er = $0	er = $0	er = $700 - $2,500	er = $4,700 - $6,500	er = $700 - $2,500	er = $4,700 - $6,500	er = $4,700 - $6,500	er = $4,700 - $6,500	er = $4,000
13	Harvard Avenue @ Waverly Place	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0	er = $0
14	West Avenue @ Waverly Place	n.a.	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $0	er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500
15	Long Ridge Road @ Stillwater Road	n.a.	n.a.	n.a.	• Green time shift. ($700 - $2,500)	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		er = $0	er = $0	er = $0	er = $700 - $2,500	er = $0	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500	er = $700 - $2,500

Mitigation to LOS E

Number	Intersection	Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
16A	Long Ridge Road @ Merritt Parkway EB	n.a.	• Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Widen the SB approach from two to three lanes by upgrading the shoulder to provide an exclusive right-turn lane. ($20 - $30,000) • Widen the EB approach from two to three lanes by a left-turn lane and two right-turn lanes. ($20 - $30,000) • Adjust signal phasing. ($700 - $2,500)	• Adjust signal phasing. ($700 - $2,500)
		cr = $0	*cr* = $700 - $2,500	*cr* = $20,700 - $32,500	*cr* = $20,700 - $32,500	*cr* = $700 - $2,500	*cr* = $20,700 - $32,500	*cr* = $20,700 - $32,500	*cr* = $40,700 - $62,500	*cr* = $700 - $2,500
16B	Long Ridge Road @ Merritt Parkway WB	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
		cr = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500	*cr* = $700 - $2,500
17	Washington Boulevard @ Broad Street	• Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen all four approaches from 10 to 12-foot lanes. ($40 - $60,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen the NB approach lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen the NB and SB approach lanes from 10 to 12 feet. ($20 - $30,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen all four approaches from 10 to 12-foot lanes. ($40 - $60,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from one left-turn lane, two through lanes, and one right-turn lane to one left-turn lane, two through lanes, and one shared through/right-turn lane. ($4,000) • Widen the EB approach lanes from 10 to 12 feet. ($10 - $15,000) • Green time shift. ($700 - $2,500)
		cr = $700 - $2,500	*cr* = $4,700 - $6,500	*cr* = $4,700 - $6,500	*cr* = $44,700 - $66,500	*cr* = $4,700 - $6,500	*cr* = $14,700 - $21,500	*cr* = $24,700 - $36,500	*cr* = $44,700 - $66,500	*cr* = $14,700 - $21,500
18	Atlantic Street @ Tresser Boulevard	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000)	• Widen the NB approach from three to four lanes to include an exclusive right-turn lane. ($20 - $30,000) • Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000)	• Reconfigure the SB approach from a left-turn lane, two through lanes, and a right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Reconfigure the WB approach from one left-turn lane, two through lanes, and one shared through/right-turn lane to two left-turn lanes, one through lane, and one shared through/right-turn lane. ($4,000) • Green time shift. ($700 - $2,500)

Mitigation to LOS E

Existing	Scenario A	Scenario B	Scenario C	Scenario B with 10% TDM	Scenario C with 20% TDM	Scenario C with Double Transit	Scenario C with Housing	Scenario C with Housing, Double Transit, 20% TDM
er = $8,700 - $10,500	*er* = $8,700 - $10,500	*er* = $28,000 - $38,000	*er* = $28,700 - $40,500	*er* = $8,700 - $10,500	*er* = $28,000 - $38,000	*er* = $8,000	*er* = $28,000 - $38,000	*er* = $8,700 - $10,500
n.a.	n.a.	n.a.	• Green time shift. ($700 - $2,500)	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)
er = $0	*er* = $0	*er* = $0	*er* = $700 - $2,500	*er* = $0	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $700 - $2,500
n.a.	n.a.	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	• Green time shift. ($700 - $2,500)	n.a.
er = $0	*er* = $0	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $700 - $2,500	*er* = $0
15	10	7	5	7	5	5	5	6
6	10	12	11	13	13	14	12	13
1	2	3	6	2	4	3	5	3